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FOREIGN TECHNOLOGY DIVISION

WORK AT THE SEMINAR "PHYSICS AND CHEMISTRY OF THE PROCESSING OF MATERIALS WITH CONCENTRATED ENERGY FLOWS"

by

A. S. Stolbunov

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EDITED TRANSLATION

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

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WORK AT THE SEMINAR "PHYSICS AND CHEMISTRY OF THE PROCESSING OF MATERIALS WITH CONCENTRATED ENERGY FLOWS"

A. [illegible] Stolbunov

On 11 November 1971 at the Institute of Metallurgy im. A. A. Baykova, AS USSR the 32nd regular seminar "Physics and chemistry of the processing of materials with concentrated energy sources" took place. It was devoted to the magnetic-pulsed processing of materials. Attending the seminar were representatives of scientific-research institutes and higher schools from Moscow, Kiev, Minsk, Kharkov, Chebcksar, Kazan', Kuybyshev, Omsk, and other cities of the country.

All the reports and communications presented can be broken down conditionally into two groups: reports, dealing with the strong influence of pulsed magnetic fields on conducting materials, methods of calculation of electrodynamic effects, construction of installations for magnetic pulsed treatment, and reports dealing with the mechanism of deformation, and structural changes in the materials after pulse-magnetic treatment. (Russian translations)

In the report "Theory and technology of magnetic-pulsed processing of metals," which was made by a group of authors (V. N. Bondaletov, V. P. Ga'yetov, B. E. Gerdo, G. M. Goncharenko, A. I. Ivanov, Ye. N. Chernov, S. I. Solov'yev), Yu. A. Popov (Cheboksary) covered the methods of calculation of electromagnetic processes in the case of discharge of a capacitive accumulator into a system of two inductively connected loops and the interconnection of electrodynamic forces with the parameters of the part being treated. The authors

[illegible]ated that the solution of Maxwell equations in the case of [illegible]tic-pulsed treatment is possible only for very limited cases [illegible]stems with a simple geometry), therefore methods of the theory of circuits was used, and on their base simplified methods were developed for the calculation of electrodynamic forces.

The report "Force influence of pulsed magnetic fields on conducting materials" by V. N. Bondaletov, Ye. N. Chernov, S. A. Kalikhman, A. I. Andreyev, V. P Gel'yetov, and Yu. P. Pigulen (Cheboksary) was devoted to finding the optimal modes of the force influence of pulsed magnetic fields on a material (magnitude and form of electrodynamic forces, mechanical work and efficiency of the process, shifting and throwing of the billet). The methods of the field theory used in the calculation made it possible to determine, with a calculation of boundary effects, the distribution of induced currents on the surface of an accelerated body, the strength of the magnetic field and its pressure in time and space. The investigation of the movement of conductors in a pulsed magnetic field was made relative to induction systems, which ensure the effective noncontact throwing of them. The investigation of a system of nonlinear differential equations was made in a dimensionless form on analog and digital computers, in this case the solution turns out to be a function of several dimensionless parameters of the system. The area of possible change of these parameters of the system and conditions of optimization of the process were determined, and also the influence of forces of resistance of the medium on the process of acceleration was taken into account. Lying at the basis of the theoretical and experimental investigation was the finding of the optimal density of current in the accelerated conductor under the assumption that acceleration is conducted prior to the onset of melting of the conductor. In the experimental investigations a rate of several km/s was achieved.

In the work by G. S. Belkin (Moscow) "Method of approximate calculation of the magnitude of erosion of electrodes in installations for magnetic-pulsed treatment of metals" approximate analytical expressions are given for erosion in a dependence on the thermophysical properties of the electrode material and the parameters of the pulse of current, and an evaluation is made of wear and the period of

of commutating devices in installations for magnetic-pulsed treatment of materials. The experimental data cited agree well with the proposed dependences.

In their report, V. K. Kostrik (Omsk) and S. M. Kolesnikov (Moscow) presented the results of theoretical and experimental investigations of the kinematics and mechanism of deformation of a cantilever-restrained tubular billet. The theoretical investigations, carried out with the use of the momentary rigid-plastic theory, showed that the kinematics and mechanism of deformation are determined by the magnitude of the load and the dimensions of the compressed end of the billet. The experimental dependences obtained showed a satisfactory qualitiative and quantitative convergence with the calculated data on the stage of acceleration of the billet, and a qualitative convergence on the stage of its slowing down.

The report by Ya. V. Kravtsov, E. N. Ponomarev, and A. S. Stolbunov (Moscow) was devoted to a consideration of the kinematics of deformation of a plate under the action of electrodynamic forces right up to fracture. They considered loads: concentrated in the center and on the periphery, and uniformly distributed; it is shown that a qualitative picture of deformation is preserved durng these types of load, and a field of rates of deformation is obtained, according to which the work of deformation and, consequently, the necessary energy of the installation, were determined.

In the report by Sh. G. Namayev, V. A. Smirnov, and A. F. Akhmerov (Kazan') experimental data are given on the shaping of sensitive elements (diaphragms) by the energy of a pulsed magnetic field; it was demonstrated that in order to obtain satisfactory parameters of the sensitive elements it is necessary that they be shaped through an intermediate medium (rubber, polyurethane).

In the report by V. B. Khardin and D. I. Lysenko (Kuybyshev) results are given from an investigation of plasticity of aluminum alloys in the process of deformation by a pulsed magnetic field, and also the post-deformation mechanical characteristics and structural changes in these alloys. It was revealed that the maximum tangential deformation of the samples exceeds by 2-4 times the maximum tangential deformation in the case of static loading, which is connected with the more uniform distribution of thinning, and also

the heating of the material by induced currents.

Ye. G. Ivanov (Cheboksary) considered the axisymmetric distribution of a thick-walled tube of infinite length by electrodynamic forces, distributed uniformly along the axis of the tube, under the assumption that the material is imcompressible, in this case the connection of stress with deformation is approximated by a dependence of the arc tangent type. A dimensionless equation is obtained which was solved on a digital computer for a number of values of parameters. After processing, the results obtained are presented in the form of analytical expressions which agree satisfactorily with numerical solutions.

V. Z. Bengus (Kharkov) in his presentation acquainted [the participants] with works being conducted in the area of creation of installation and means for measurement of pulsed currents and stresses.

Those who came forth in the discussion noted the necessity of an exchange of information between the specialists in different branches of knowldege which deal with the area of magnetic-pulsed treatment of materials.

N. N. Rykalin, in summing up the seminar, noted the most promising trends of development of theoretical and experimental investigations and informed the participants on how the following seminar would be conducted.

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